NORTHERN SPOTTED OWL MONITORING
ANNUAL REPORT, FY 2010 6 February 2011

1. **Title**:

   Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) in the Klamath Mountain Province of Oregon, 1990-2010.

2. **Principal Investigators and Organizations**:

   Ray Davis (Principal Investigator); R. Horn (Lead Biologist); Biologists: P. Caldwell, S. Cross, R. Crutchley , K. Fukuda, C. Larson, H. Wise.

3. **Study Objectives**:

   The study objectives are to estimate the population parameters of northern spotted owls on the Klamath Study Area (KSA) within the Klamath Mountain Province. These parameters include occupancy, survival and reproductive success. The lands are administered by the Glendale and South River Field Offices of the Medford and Roseburg Districts of the USDI Bureau of Land Management (BLM).

4. **Potential Benefit or Utility of the Study**:

   The KSA is one of 8 long-term northern spotted owl study areas designed to assess trends in spotted owl populations and habitat as directed under the Northwest Forest Plan (USDA and USDI 1994). The data from these studies were recently analyzed as part of a rangewide meta-analysis workshop (Forsman et al. in press). The survival and reproductive data has and will be used in population modeling to assess the long-term stability of the population (Franklin et al. 1999). Data from several study areas has and will be used in the development of habitat predictive models for the spotted owl (Lint et al. 1999, Anthony et al. 2000).

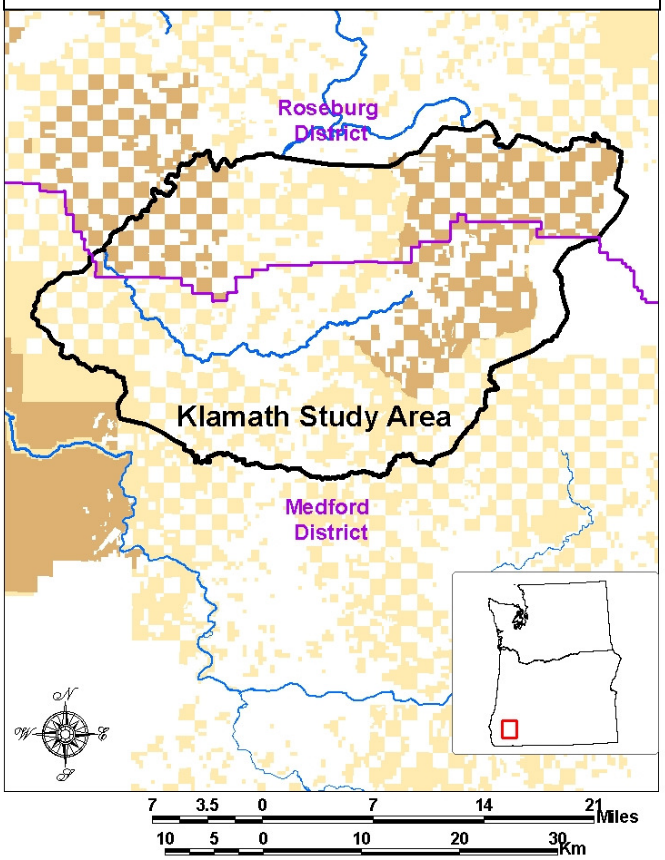
5. **Study Area Description and Survey Design**:

   The KSA is located within the Klamath Mountains Province in SW Oregon and is approximately 1422 km^2 (351,334 ac) in size (Figure 1). This province is characterized by mixed conifer forests dominated by Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). Other species common include pine (*Pinus* spp.), grand fir (*Abies grandis*), pacific madrone (*Arbutus menziesii*), golden chinquapin (*Castanopsis chrysophylla*), and oak (*Quercus* spp.) (Franklin and Dyrness 1973). Sites within the current boundaries of the KSA were systematically surveyed from 1997-present. A smaller study area (about 466 km^2; 115,138 ac) was systematically surveyed from 1990-1994 and is encompassed within the current boundaries.

   The KSA includes portions of 2 BLM Districts in Western Oregon (Medford and

Roseburg), and much of the intervening areas of private and state lands. The federal lands are primarily in an alternating "checkerboard" pattern of ownership with private lands. Of the 8 long-term studies, 2 of them (Klamath and Tyee) are composed almost entirely of this checkerboard pattern of ownership. Two types of study areas are included in the 8 long-term studies, density study areas where all of the area within the boundary is surveyed each year, and territorial study areas where all known past and present owl territories are surveyed each year. The KSA is a territory based study area.

Figure 1. Klamath Study Area boundary. Yellow and brown represent federally administered lands, brown represents LSR.



The Northwest Forest Plan (NWFP) designates forestland into several Land Use Allocations (LUA's). One such LUA is designated Late Successional Reserve (LSR) and is designed to provide a functional late-successional and old growth forest ecosystem. The KSA includes part or all of 2 LSR areas designated under the NWFP.

The checkerboard pattern makes analysis by ownership or LUA difficult as virtually all sites within an LSR designation also encompass non-LSR within their home range. For the purpose of this analysis, a line was drawn around each of the 2 LSR's in the study. If sites were located within these boundaries they were considered in LSR, even though the private land within these boundaries is not actually designated as LSR.

The study monitors demographic parameters including survival rates, reproductive rates, and annual rate of population change. The protocol currently used to determine site occupancy, nesting, and reproductive status for this study follows the guidelines specified by the Northern Spotted Owl Effectiveness Monitoring Plan for the Northwest Forest Plan (Lint et al. 1999). An attempt is made to uniquely color band or reobserve all previously banded individuals within the study. The reobservation of banded owls will be used for the calculation of survival rates and population trends (Franklin et al. 1999, Burnham et al. 1996, Anthony et al. 2006, Forsman et al. in press).

6. <u>Results for FY 2010</u>:

Survey Effort

There are currently 156 known spotted owl sites within the KSA. During the period of study, it was determined that 4 sites that were considered separate sites were different use areas of another site and have been combined. Of the 156 sites surveyed during 2010; 67 were occupied by a pair, 12 by a single, and 15 were occupied by 1 or 2 owls with unknown status (Appendix A). At least one spotted owl was detected at 94 (60.3 %) of the sites. No new sites were documented within the study during 2010, and only 1 site has been added since 2007. Consistent occupancy by a territorial single or a pair is the usual criteria for designating a new site.

Spotted Owl Detections and Banding by Sex and Age

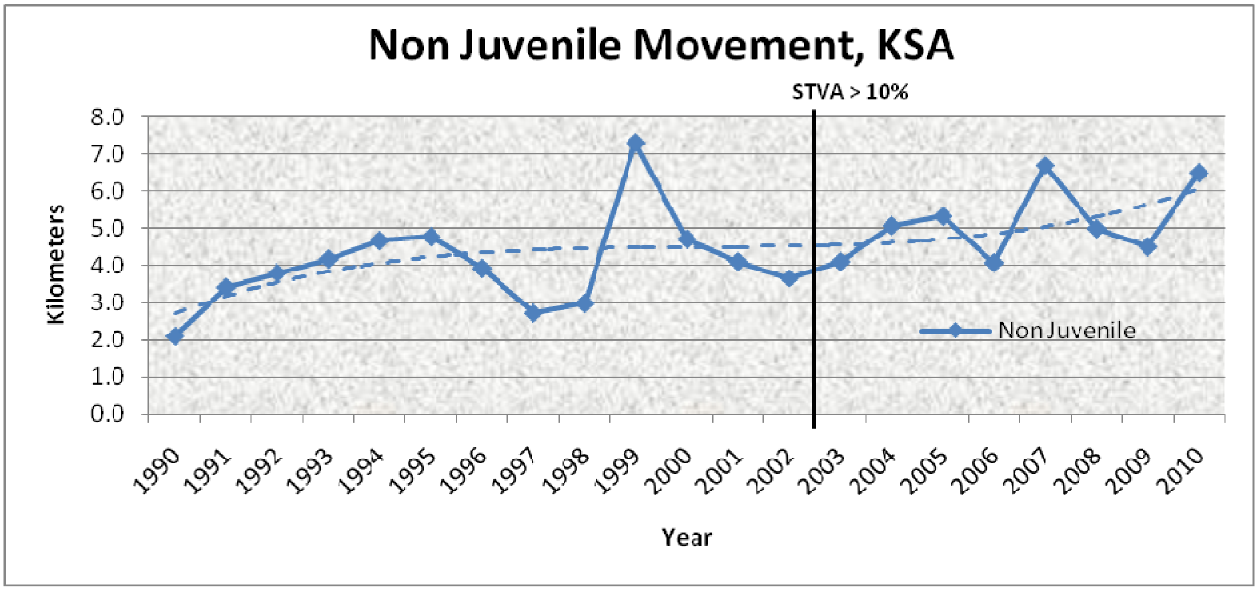
A total of 167 non-juvenile spotted owls were detected on the KSA during 2010, of which 88 were males and 79 were females, resulting in a male:female sex ratio for non-juveniles of 1.11:1. Of the 147 non-juvenile owls on the KSA where age was determined, 135 (91.8%) were adults and 12 (8.2%) were subadults (Appendix B). The oldest known owl within the KSA was a male that was at least 22 years old. The oldest known female was at least 17 years old. A total of 36 owls were newly banded on the KSA during 2010. Of these, 31 (86.1%) were fledglings, 1 (2.8%) was an adult, and 4 (11.1%) were subadults.

During 2010, of the 13 owls encountered for the first time as non-juveniles on the study, the ages of 10 (76.9%) were known exactly or within 1 year. On the KSA during 2010, 1 non-juvenile was a known immigrant and no non-juveniles were known emigrants. A total of 11 owls originally banded as juveniles within the KSA were recaptured for the first time during 2010, 5 of which were recaptured within the KSA. The longest distance moved for a juvenile banded within the study and relocated during 2010 was 49.5 km (30.8 mi) from the point of original banding, and the longest distance moved for a non-juvenile banded within the study and relocated during 2010 was 34.7 km (21.6 mi) from the point of previous confirmation. The average distance for recoveries of dispersing males during 2010 was 18.4 km (11.4 mi) (N=5) and for females was 28.7 km (17.8 mi) (N=6). The average distance for movements of non-juvenile males during 2010 was 5.0 km (3.1 mi) (N=9) and for females was 8.5 km (5.3 mi) (N=7) (Figure 2).

Spotted Owl Reproduction

Yearly reproductive data (1990-2010) (Appendix C, D) includes nest success, fecundity rate, and mean brood size. The proportion of females nesting is defined as the number of females that attempted to nest compared to the total where nesting status was determined. Nest success is defined as the proportion of nesting females that fledged young. The fecundity rate is defined as the number of female young produced per female where the number of young produced was determined. The mean brood size is defined as the average number of young produced per successfully reproducing pair. Where appropriate, the data were split into 4 female age classes; 1-year old, 2-year old, adult, and unknown age. The reproductive data were analyzed 2 ways: 1) the entire KSA, and 2) divided into 2 groups (LSR and non-LSR) (Appendix E).

Figure 2. The annual average distance of non-juvenile movements within the KSA (1990-2010). All movements are included; internal, immigration, and emigration. A polynomial trend line is plotted. The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.



During 2010, there were a total of 60 sites where nesting status was determined, 47 nested (78.3%) and 13 did not nest (21.7%). Of the sites where nesting occurred during 2010, 23 pairs successfully fledged young and 24 pairs nested and failed, resulting in a nesting success rate of 48.9% (Appendix D).

Table 1. Fecundity rate and mean brood size by age class of female within the KSA (1990-2010). Sites where backpack transmitters were attached to females during the nesting season were excluded from the calculation during the years of attachment. (a)

Age class	Mean fecundity (N), 1990-2010	95% CI for fecundity	Mean brood size (N), 1990-2010	95% CI for brood size
1-yr	0.064 (94)	0.016-0.111	1.71 (7)	1.35-2.08
2-yr	0.299 (137)	0.232-0.366	1.47 (53)	1.33-1.60
Adult	0.356 (1275)	0.332-0.379	1.59 (570)	1.54-1.63
Unk	0.238 (40)	0.132-0.343	1.27 (15)	1.04-1.50
Total	0.338		1.57	

(a) Preliminary data, values may change.

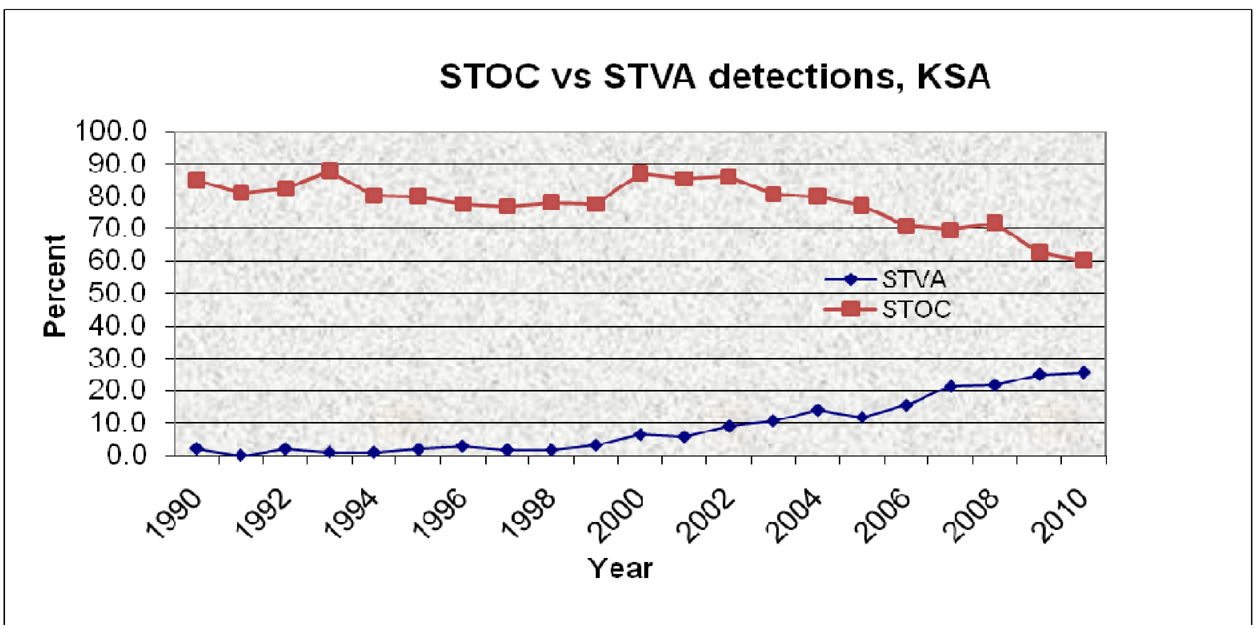
The fecundity rate for the entire KSA during 2010 was calculated at 0.264 (Appendix C). The fecundity rate for 2010 within LSR boundaries was 0.317 and within non-LSR boundaries was 0.225. The fecundity rate for all sites during the years 1990-2010 was split into 4 female age classes. The rate for 1-year olds (0.064) was much lower than 2-year olds (0.299), adults (0.356), and unknown (0.238) (Table 1). Neither of the 2 pairs with a 1-year old female attempted to nest.

In 2010, the mean brood size (1.39) was lower than the average for the years 1990-2010 (1.57). The mean brood size for the years 1990-2010 was split into 4 female age classes, all resulted in similar values (Table 1).

Barred Owl

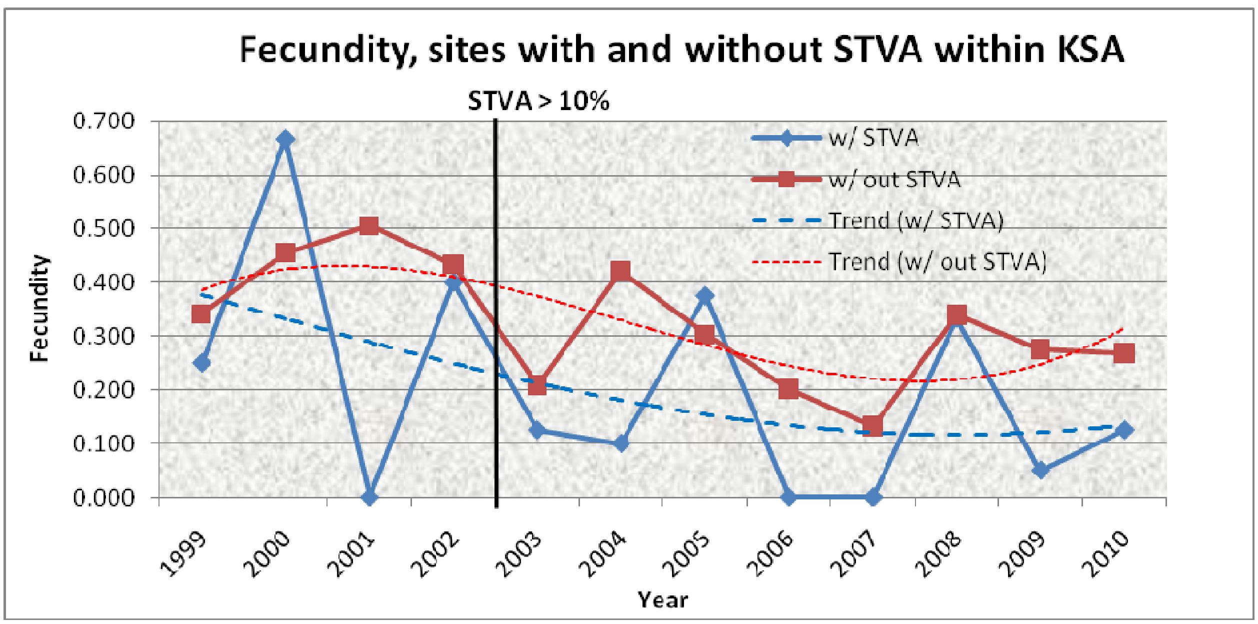
There were at least 61 non-juvenile barred owls (*Strix varia*) detected on the KSA during 2010. Within the KSA, we detected a pair of barred owls at 19 sites and 1 site that consisted of a spotted owl paired with a spotted-barred owl hybrid. This pair produced 1 fledgling. At least 4 of these sites were known to have fledged young. We compared the percentage of sites that were surveyed where at least one spotted owl was detected versus at least one barred owl detected (Figure 3). The barred owl detections were incidental to spotted owl surveys, therefore the number of sites with at least one barred owl detection is probably underestimated. The percentage of sites surveyed for spotted owls with barred owl detections is trending upward from a relatively low 1.7% in 1998, to 10.7% in 2003, 21.8% in 2008, and 25.6% in 2010 (Appendix A). The percentage of sites with a barred owl detection exceeded 10% for the first time during 2003, and remained above 10% since.

Figure 3. Percentage of sites surveyed with at least one spotted owl detection versus sites with at least one barred owl detection. Klamath Study Area, 1990-2010.



We compared the fecundity rate of spotted owls at sites with barred owl detections and sites without known barred owl detections (Figure 4). These numbers should be viewed with caution since barred owl detections were incidental to survey efforts for spotted owls. The first year barred owls were detected at any spotted owl site where spotted owl reproduction was determined was in 1999. From 1999-2010, the fecundity rate was 0.183 (0.096-0.270, N=60) for sites with barred owl presence, and 0.324 (0.298-0.351, N=937) for sites without known barred owl presence. The fecundity rate during 2010 was 0.125 (N=4) for sites with barred owl presence, and 0.269 (N=67) for sites without known barred owl presence. Before barred owl detections exceeded 10% of the sites within the study area (1990-2002), the fecundity rate for all sites was 0.390 and the fecundity rate was 0.254 after the barred owl detections exceeded 10% (2003-2010). At sites with known barred owl presence during 2010, the sample size was too small (N=2 and N=1) to make estimates of nesting attempts and nest success. At sites without known barred owl presence during 2010, nesting attempts were 82.8% (N=58) of the sites with nest status determined, and nest success was 47.8% (N=46).

Figure 4. Spotted owl fecundity rate at sites with and without known STVA detections (1999-2010). Polynomial trend lines are plotted. The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.



7. <u>Discussion for FY 2010</u>:

Survey Effort

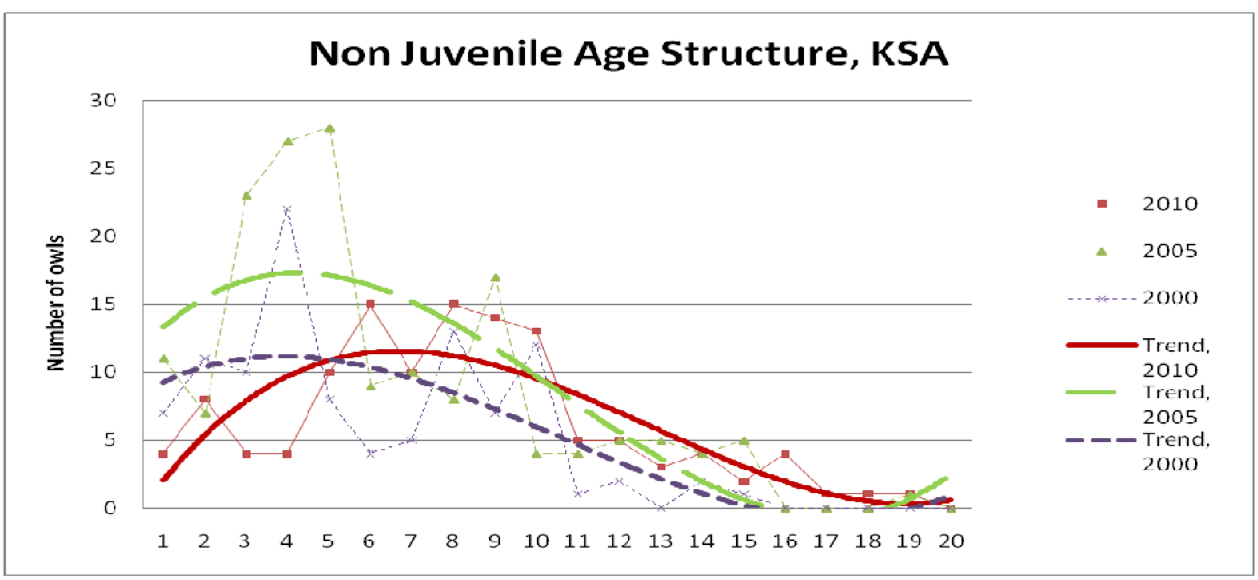
The survey effort within the KSA has varied over time, however the general trend has been an increase in the number of sites located and surveyed (Appendix A). The KSA boundaries were established in 1997 and the survey effort increased significantly at that time. The number of sites located within the KSA has remained relatively stable recently since much of the available habitat has been surveyed. Although most of the area within this boundary is covered by territorial surveys, it is not a density study and some area may still not be surveyed.

Spotted Owl Detections

The increase in individual spotted owl detections through 2002 corresponds with the increase in the number of sites surveyed on the KSA. The number of owls detected is no longer increasing as all possible owl sites were located, and has actually begun to decrease since the 2002 survey season. In recent years, there has been a steady decline in the total number of non-juveniles detected (Appendix B) and an even larger decrease in the number of pairs detected (Appendix A).

The decrease of the number of subadults detected is even more pronounced than the decrease of all non-juveniles combined. The highest proportion of subadults ever documented in the KSA (24.1% in 2002, 25.9% in 2003) occurred early in this decade and it has dropped to under 10% the past 6 years (Appendix B). Some of this decline may be explained by multiple years with low fecundity (1993, 1995, 2006, 2007) corresponding to subsequent years with low numbers of subadults recruited into the population, however the recent decline is an extended period of low recruitment, with 2008 and 2009 being the lowest during the entire study period. Another indicator of recruitment is the number of juveniles banded on the KSA that survive and are subsequently recaptured. The highest number of internal recruits was 20 in 2003 which was preceded by 3 consecutive years of very high fecundity rates. During 2010 there were 5 juveniles previously banded within the KSA that were recaptured within the KSA, compared to 9 in 2009, 5 in 2008, 17 in 2007, 9 in 2006, and 12 in 2005.

Figure 5. Age structure within the KSA, during 3 time periods. Only spotted owls with ages known within 1 year are included. Polynomial trend lines are plotted.



A majority of the non-juvenile owls encountered for the first time (73.3% in 2008, 82.3% in 2009, 76.9% in 2010) were of known age or known within 1 year. Known age owls are a result of banding juveniles or locating and banding owls while they were still in the subadult age class. Knowing the age structure of the population allows flexibility for current and future analysis. Individuals of exact age were banded as juveniles, while those of approximate age (within 1 year) were initially banded as subadults, and individuals of minimum age (3+ years) were initially banded as adults. Figure 5 illustrates the age structure during 3 time periods, using only known or approximate age individuals. Using 2000 as the first age structure time period should reduce the bias associated with excluding minimum age individuals. Banding was initiated in the late 80's, therefore most known or approximate ages of the older age cohort during 2000 will be documented, while few minimum age individuals will remain in the population. The r^2 values for the trend lines are 0.684 for 2010, 0.625 for 2005, and 0.598 for 2000. Most of the population is comprised of 4-8 year ages, which agrees with the results from Loschl (2008) whose data for an Oregon study showed that the average life span was 7-9 years. The age structure for 2010 is showing a shift towards an older age structure. The combination of the recent leveling or decrease in recruitment, an older age structure, plus the decrease in pair detection, may be cause for concern.

Spotted Owl Demographics

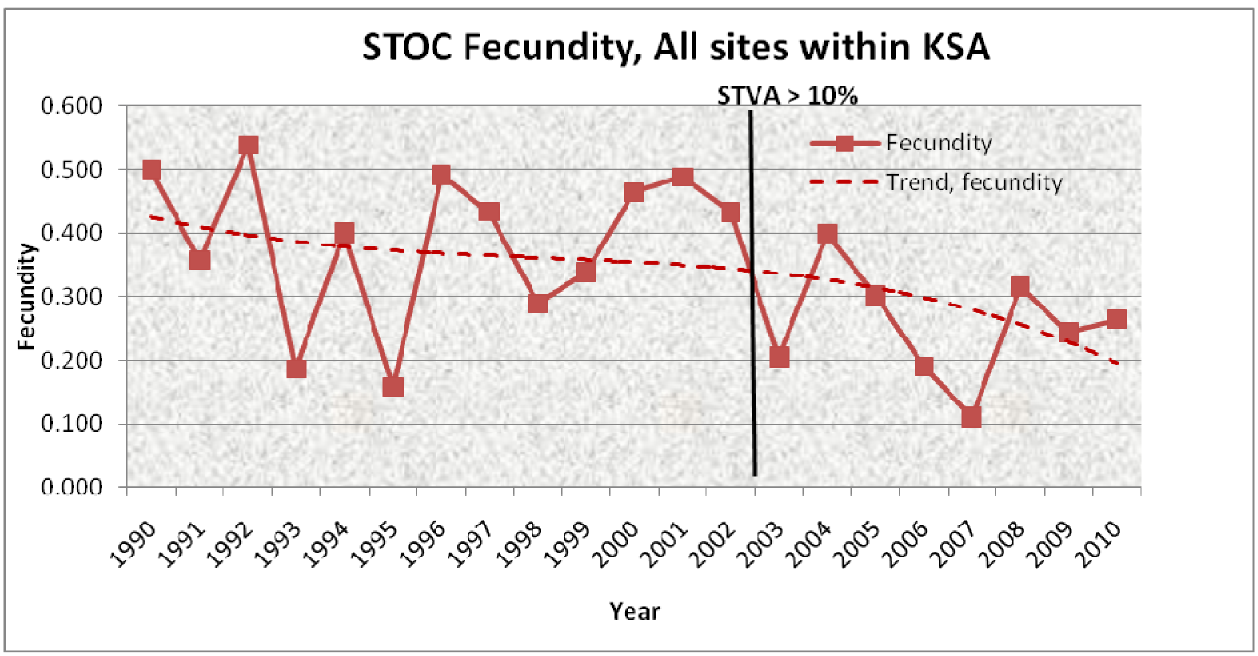
During 2010, the nesting status was determined at 60 (84.5%) of the sites where reproduction was eventually determined. During most previous years, nest status determination was consistently high (2008, 90.5%; 2009, 88.5%). Locating nesting pairs before 1 June is not required to determine reproduction, but it has several benefits. One benefit is a more accurate determination of nest success, which is the number of pairs that attempted to nest and actually fledged young. Another benefit is a more accurate count of the number of young fledged. If the nest tree location is known, reproductive visits can be timed soon after fledging occurs to avoid the effects of early juvenile mortality which would lead to the undercounting of nesting success.

The nest success rate for 2010 was 49% and was the lowest ever calculated for the study area. This compares to the average of 75% from 1990-2010 (Appendix D). Six of the previous 8 years (2003-2010) were documented with a lower than average nest success rate. The 2010 mean brood size was 1.39 and was lower than the average for all years (1.57, Appendix C), and only 3 of the previous 20 years were a lower estimated mean brood size. Four of the previous 8 years (2003-2010) were a higher estimated brood size than the average for all years. The combination of very low nest success and low brood size in 2010 may be cause for concern. The low nest success rate may be partially explained by the cool and wet spring. Rainfall within the KSA during April 2010 was the highest of any April during the study, and the third highest during the combined months of March through May. Glenn (2009) noted that there were negative associations with nest season precipitation during the early nesting season within the Tyee Density study just north of the KSA. This may help explain the extremely low nest success rate during 2010, but does not account for the recent trend of lower nest success.

The fecundity rate for 2010 was 0.264, and was lower than the average for the years 1990-2010 (0.338) (Appendix C). While the fecundity rate is known to fluctuate, we documented only 1 year during the most recent 8 years where the fecundity rate was above the overall average, indicating a downward trend (Figure 6). In addition, the number of pairs detected at sites declined during that same time period, and the number of unoccupied sites increased. The number of sites surveyed during this period has remained relatively constant. We documented an increasing fecundity rate from 1-year old to adult age classes. Our most recent analysis shows a very low fecundity rate for 1-year olds, while the rate for 2-year olds was similar to, but slightly lower than the adult rate (Table 1). This follows the trend that Loschl (2008) reported for data from the Oregon Coast Range, where the mean annual number of young fledged increased at a constant rate from 1-year old through 4-year olds, then remained constant. Loschl noted that using only 3 age classes misses some of the variation in the older ages. We may want to consider future analysis using actual ages to determine if the trend Loschl noted also occurs within the KSA.

Although fecundity rates varied by age class, the mean brood sizes did not appear to differ greatly among age classes. The number of juveniles detected within the KSA during 2010 (38) was lower than the overall median (Appendix B). Only 4 of the previous 20 years had fewer juveniles detected, and the highest numbers ever documented were during 2001 and 2002, even though there were fewer sites surveyed during those years.

Figure 6. Spotted owl fecundity at all sites surveyed, KSA 1990-2010. A polynomial trend line is plotted. The vertical line represents the first year STVA detections exceeded 10% of the sites surveyed.



The yearly fecundity rates for sites within an LSR compared to sites outside the LSR boundary are given in Appendix E. The NWFP became effective in the spring of 1994. Data presented here are for the combined years before and after the effective date.

Fecundity rates for LSR sites compared to non-LSR sites, both before and after the NWFP implementation, indicate similar trends. There was a slight decrease in fecundity after the NWFP implementation for both LSR (0.407 versus 0.315) and non-LSR (0.386 versus 0.323) sites. The fecundity rate during 1990-2010 was virtually identical for LSR sites and for non-LSR sites. In recent years, the number of sites where fecundity was determined decreased for both LSR and non-LSR sites, indicating there may be a population decline within the area. Currently the harvest level on federal forest is quite minimal, while the harvest on private ownership has occurred at about the same rate both inside and outside the LSR boundary. The differences in fecundity rates may be more meaningful as more timber is harvested from non-LSR federal land.

Barred Owl

It is clear that the barred owl population is increasing across the range of the northern spotted owl. The most recent meta-analysis (Forsman, in press) indicates that the spotted owl populations have declined across most of the range, with the most significant declines occurring in Washington where the barred owl has been present the longest. Although analysis within the KSA indicates a stable spotted owl population during the study period, the recent data shows the beginning of a trend towards a declining population. The numbers of barred owls continue to increase, while spotted owl occupancy and fecundity continues to decrease.

There were 61 non-juvenile barred owls detected on the KSA. This number was higher than the number detected in 2007 (46), 2008 (44), and 2009 (58), and was the highest number detected during any previous year. Using simple presence at a site, there was a proportional increase in the number of sites with barred owl detections during the last few years. Beginning in 2003, barred owl's were detected at more than 10% of the sites surveyed in each subsequent year, and never exceeded 10% in any previous year (Figure 3). During 2010, the percent of sites where barred owls were detected was the highest of any year, and the percent of sites where spotted owls were detected was the lowest of any year. The 40 sites where barred owls were detected in 2010 is a tenfold increase from the 4 sites with detections in 1999.

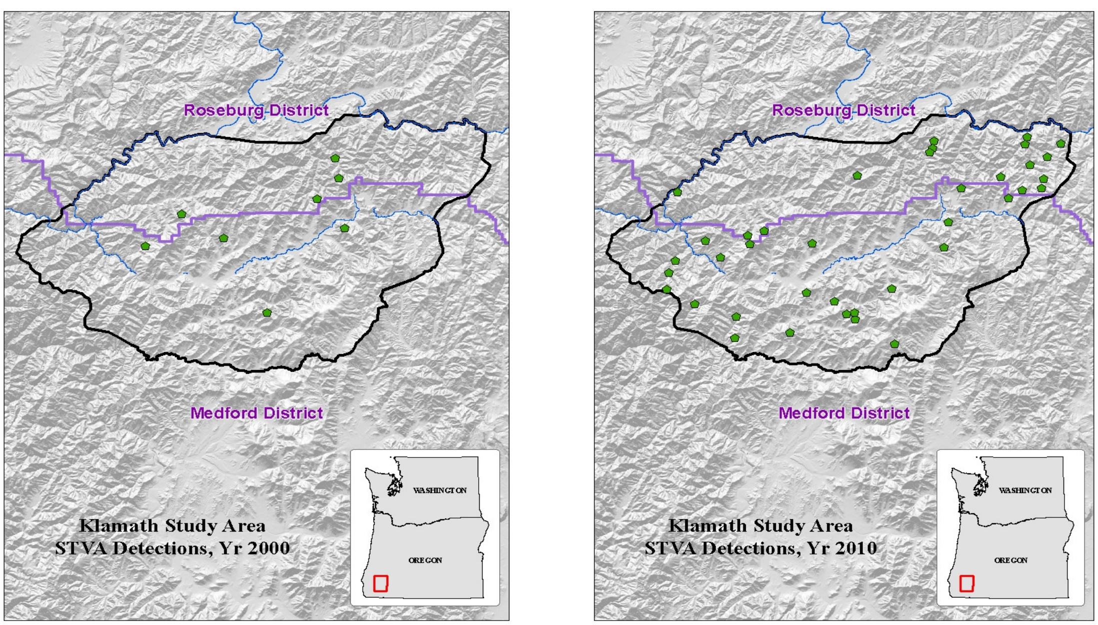
Barred owls may be less likely to be detected at sites that are occupied by spotted owls. These sites tend to initially receive more focused diurnal visits to known high use areas and less complete coverage of the territory compared to unoccupied sites which are thoroughly surveyed with at least 3 night visits throughout the season. Therefore, the number of sites with at least one barred owl detection probably underestimates the actual number of barred owls present, especially at sites with spotted owl detections. Bailey et al. (2009) noted that barred owls were often twice as likely to be detected if spotted owls were not present. Figure 7 illustrates the change in known barred owl occupation at sites, comparing 2000 to 2010 (8 sites versus 40 sites). This change is even more pronounced if comparisons are made using detections during a combination of 2 years, 10 different sites for the years 1999-2000, and 57 different sites for the years 2009-2010.

The decrease in spotted owl detections since 2002 corresponds to an increase in barred owl presence (Figure 3). It has been shown (Bailey et al. 2009, Crozier et al. 2006) that the presence of barred owls negatively affects the detection probabilities of spotted owls. This may account for some of the decrease in spotted owl detections, however it is quite possible the barred owl is actually having an impact on the population. It has been shown (Olson et al. 2005) that barred owl presence positively affected local-extinction probabilities or negatively affected colonization probabilities of spotted owls. They concluded that further declines in the proportion of sites occupied by spotted owls is expected, and the population on the KSA seems to be experiencing these effects.

There has been a rapid increase in barred owl detections on the Tyee Density study area north of the KSA (Forsman et al. 2010). On the Tyee Density study, the number of sites with barred owl detections exceeded the number of sites with spotted owl detections for the first time in 2009. The percent of sites where barred owls were detected exceeded 50% during the past 4 years and never exceeded 50% previous to that time. The graph in Figure 3 appears similar to the Tyee data through 2002, indicating the barred owls will continue to increase in the KSA as well. It is probable that barred owls will continue their expansion south affecting spotted owl detections and population trends (Kelly 2001).

Data on the number of non-juvenile movements within the study were fairly consistent over recent time, 16 in 2010, 17 in 2009, 17 in 2008, and 20 in 2007. Earlier years previous to large numbers of barred owl detections resulted in fewer movements, 5 in 1995, 16 in 1994, 5 in 1993, and 6 in 1992. Since about 32% fewer sites were surveyed in the earlier years, the numbers are not directly comparable but data on the distance of adult movements (Figure 2) indicates an upward trend in recent years. It has been postulated that the spotted owl population will experience internal movements in reaction to barred owl disruption of territories. These data indicate a disruption of territorial fidelity may have begun.

Figure 7. Barred owl detections on the KSA, 2000 and 2010. Green dots represent a site with at least a single barred owl detection during the year.



We compared fecundity rates at sites with and without barred owl detections from 1999-2010. Because barred owl detections were incidental, the results from sites where spotted owl reproduction was determined may be biased low regarding barred owl detections. However, any survey bias for reproductive versus non reproductive sites should be somewhat similar since most visits occur diurnally. The fecundity rate from 1999-2010 from sites with known barred owl presence was 0.183 compared to 0.324 from sites where barred owls were not detected. There was no overlap in confidence intervals for these estimates. During this time, the fecundity rate was higher in 2 of 12 years for sites with known barred owl presence versus sites with no known barred owl detections, but one of those 2 years (2000) included a very small sample size. The fecundity rate using only the 2010 data at sites with known barred owl presence was 0.125 compared to 0.269 at sites where barred owls were not detected. The highest number of juveniles produced on the KSA was during 2001 and 2002, the time period just before barred owl detections exceeded 10%. These individual and cumulative year data indicate barred owl presence may be having a negative impact on spotted owl reproduction and is consistent with findings from Olson et al. 2004. Glenn (2009) also noted that there was a negative association with barred owl presence and reproduction in her meta-analysis.

There is mounting evidence that barred owls are negatively impacting spotted owl population within the KSA. This is illustrated by several population trends beginning about 2003, which is when barred owl detections within the KSA exceed 10% of the sites. Spotted owl detections have been steadily decreasing since 2002 (Figure 3) and reached the lowest point in 2010, the same year barred owl detections reached their highest level. Fecundity rates appear to be declining (Figure 6) during the past 8 years and in only 1 of those 8 years was the rate above average. In addition, fecundity rates for sites with known barred owl presence was lower than at other sites. If these trends continue, a combination of lower occupancy and reduced fecundity, there may be cause for concern regarding the spotted owl population.

8. Acknowledgments:

Many people and organizations contributed to the success of this project. Without the dozens of dedicated people collecting the field data, none of this could have been accomplished. In addition, biologists from surrounding areas have contributed information regarding owl movements. Several private timber companies have been gracious enough to allow access to sites on their property. The primary government agencies with land owned or administered within the Klamath Study Area are the BLM and the State of Oregon. Funding for rangewide demographic studies comes from BLM, USDA Forest Service, and the National Park Service.

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Appendix A. Territories surveyed and occupancy results by year within the KSA (1990-2010). (a)

Year	Total Sites (b)	Sites w/ STVA (c)	Sites w/ Pair (d)	Sites w/ single	Sites w/ undetermined status (e)	Total occupied sites	Sites w/ no occupation (f)	Sites w/ incomplete survey (g)
1990	93	2	58	10	11	79	14	7
1991	95	0	61	11	5	77	18	11
1992*	97	2	58	13	9	80	17	11
1993*	107	1	66	15	13	94	13	9
1994*	112	1	73	4	13	90	22	9
1995*	105	2	60	11	13	84	18	17
1996	103	3	58	7	15	80	21	19
1997	117	2	61	12	17	90	25	9
1998*	119	2	74	9	10	93	22	11
1999*	125	4	74	9	14	97	25	7
2000*	124	8	71	16	21	108	12	9
2001*	138	8	86	12	16	118	20	1
2002	144	13	96	10	18	124	16	1
2003	149	16	95	11	14	120	21	0
2004	150	21	96	10	14	120	26	0
2005	153	18	91	13	14	118	31	1
2006	155	24	89	10	11	110	36	1
2007	155	33	81	16	11	108	38	1
2008	156	34	79	13	20	112	36	0
2009	156	39	75	9	14	98	52	0
2010	156	40	67	12	15	94	51	0

(a) Preliminary data, values may change.
(b) Sites surveyed to protocol. The sum of the last 3 columns may not equal the total sites since sites with the same individual located at 2 sites are not considered as occupied at one site.
(c) STVA occupancy is opportunistic and is defined as any detection at the site.
(d) Pair as defined in Lint et al 1999.
(e) Undetermined status may include one or 2 owls, does not qualify as a pair or single.
(f) No occupancy determined with at least 3 survey visits.
(g) Incomplete survey is 2 visits or less (usually no visits, only includes sites surveyed in previous years).
* represents years with a site where the pair was comprised of a spotted owl and a barred owl which was included as a "site with single".

Appendix B. Sex and age composition of spotted owls located within the KSA (1990-2010). Non-juvenile owls where the sex could not be determined are not included. (a)

Year	Adult (M,F)	Subadult (M,F)	Percent Subadult	Age unk (M,F) (b)	Total non-juvenile (M,F)	Juvenile
1990	100 (56,44)	14 (8,6)	12.3	22 (12,10)	136 (76,60)	52
1991	112 (61,51)	16 (7,9)	12.5	14 (8,6)	142 (76,66)	40
1992	106 (61,45)	16 (6,10)	13.1	18 (11,7)	140 (78,62)	59
1993	117 (63,54)	23 (12,11)	16.4	23 (16,7)	163 (91,72)	22
1994	125 (67,58)	28 (13,15)	18.3	15 (8,7)	168 (88,80)	55
1995	118 (65,53)	9 (1,8)	7.1	20 (15,5)	147 (81,66)	18
1996	112 (61,51)	8 (4,4)	6.7	26 (14,12)	146 (79,67)	56
1997	114 (59,55)	22 (15,7)	16.2	26 (12,14)	162 (86,76)	52
1998	124 (67,57)	27 (14,13)	17.9	19 (9,10)	170 (90,80)	41
1999	131 (72,59)	16 (5,11)	10.9	31 (16,15)	178 (93,85)	44
2000	135 (74,61)	18 (9,9)	11.8	32 (19,13)	185 (102,83)	65
2001	148 (77,71)	34 (19,15)	18.7	18 (13,5)	200 (109,91)	82
2002	154 (84,70)	49 (21,28)	24.1	19 (13,6)	222 (118,104)	83
2003	152 (84,68)	53 (25,28)	25.9	12 (8,4)	217 (117,100)	38
2004	173 (93,80)	28 (11,17)	13.9	18 (13,5)	216 (115,101)	75
2005	192 (105,87)	17 (3,14)	8.2	6 (6,0)	215 (114,101)	61
2006	168 (91,77)	18 (3,15)	9.7	14 (10,4)	200 (104,96)	35
2007	159 (82,77)	16 (7,9)	9.1	14 (9,5)	189 (98,91)	19
2008	163 (83,80)	11 (4,7)	6.3	19 (12,7)	193 (99,94)	53
2009	147 (75,72)	8 (5,3)	5.2	14 (12,2)	169 (92,77)	38
2010	135 (69,66)	12 (7,5)	8.2	20 (12,8)	167 (88,79)	38

(a) Preliminary data, values may change.
(b) It is possible some of the unknown are auditory responses and the same individuals as included in another category.

Appendix C. Fecundity rate and mean brood size by year within the KSA (1990-2010). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. (a)

Year	**Mean fecundity (N)**	**95% CI for fecundity**	**Mean brood size (N)**	**95% CI for brood size**
1990*	0.500 (48)	0.376-0.624	1.60 (30)	1.42-1.78
1991*	0.357 (56)	0.238-0.476	1.67 (24)	1.44-1.89
1992*	0.538 (52)	0.422-0.655	1.51 (37)	1.32-1.71
1993	0.186 (59)	0.098-0.275	1.47 (15)	1.21-1.73
1994	0.400 (70)	0.288-0.512	1.81 (31)	1.64-1.97
1995	0.158 (57)	0.076-0.240	1.38 (13)	1.11-1.66
1996	0.491 (57)	0.386-0.597	1.47 (38)	1.31-1.63
1997	0.433 (60)	0.316-0.551	1.73 (30)	1.57-1.89
1998	0.289 (71)	0.202-0.376	1.37 (30)	1.19-1.54
1999	0.338 (65)	0.231-0.446	1.69 (26)	1.51-1.87
2000	0.464 (70)	0.366-0.563	1.51 (43)	1.36-1.66
2001	0.488 (84)	0.387-0.589	1.78 (46)	1.66-1.90
2002	0.432 (96)	0.344-0.520	1.60 (52)	1.46-1.73
2003	0.205 (95)	0.137-0.273	1.34 (29)	1.17-1.52
2004	0.399 (94)	0.312-0.486	1.56 (48)	1.42-1.70
2005	0.302 (101)	0.220-0.384	1.60 (38)	1.45-1.76
2006	0.190 (92)	0.116-0.264	1.59 (22)	1.38-1.80
2007	0.110 (87)	0.047-0.174	1.73 (11)	1.45-2.00
2008	0.315 (84)	0.231-0.400	1.43 (37)	1.27-1.59
2009	0.244 (78)	0.153-0.334	1.71 (21)	1.52-1.91
2010	0.264 (71)	0.176-0.352	1.39 (23)	1.19-1.60
1990-2010	**0.338**	SE=0.028	**1.57**	SE=0.031

(a) Preliminary data, values may change.

Appendix D. Proportion of nesting attempts at sites with nest status determined, and proportion of nest success by year within the KSA (1990-2010). Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. (a)

Year	**Nest Attempt Proportion (N)**	**95% CI for Nest Attempts**	**Nest Success Proportion (N)**	**95% CI for Nest Success**
1990*	0.821 (39)	0.563-1.078	0.750 (28)	0.587-0.913
1991*	0.696 (46)	0.495-0.897	0.700 (30)	0.533-0.867
1992*	0.783 (46)	0.556-1.009	0.871 (31)	0.751-0.991
1993	0.370 (46)	0.263-0.476	0.750 (16)	0.531-0.969
1994	0.569 (58)	0.423-0.715	0.806 (31)	0.665-0.948
1995	0.439 (41)	0.305-0.573	0.667 (18)	0.443-0.891
1996	0.846 (38)	0.577-1.115	0.844 (32)	0.716-0.972
1997	0.540 (50)	0.390-0.690	0.963 (27)	0.890-1.036
1998	0.647 (51)	0.469-0.825	0.625 (32)	0.455-0.795
1999	0.472 (53)	0.345-0.599	0.880 (25)	0.750-1.010
2000	0.776 (58)	0.576-0.976	0.844 (45)	0.737-0.952
2001	0.707 (75)	0.547-0.867	0.849 (53)	0.752-0.946
2002	0.667 (90)	0.529-0.804	0.850 (60)	0.759-0.941
2003	0.506 (83)	0.397-0.615	0.595 (42)	0.445-0.745
2004	0.600 (90)	0.476-0.724	0.852 (54)	0.756-0.947
2005	0.589 (90)	0.467-0.711	0.623 (53)	0.491-0.754
2006	0.375 (87)	0.296-0.454	0.606 (33)	0.437-0.775
2007	0.208 (77)	0.161-0.254	0.688 (16)	0.453-0.922
2008	0.592 (76)	0.459-0.725	0.800 (45)	0.675-0.925
2009	0.449 (69)	0.343-0.555	0.700 (30)	0.533-0.867
2010	0.783 (60)	0.678-0.888	0.489 (47)	0.345-0.634
1990-2010	**0.592**		**0.750**	

(a) Preliminary data, values may change.

Appendix E. Fecundity rate and mean brood size by Land Use Allocation and year within the KSA. Years with an * represent years when backpack transmitters were attached to females during the nesting season, these sites are excluded from the calculation. (a)

Year	LSR, Mean fecundity (N)	LSR, 95% CI for fecundity	Non-LSR, Mean fecundity (N)	Non-LSR, 95% CI for fecundity
1990*	0.462 (26)	0.290-0.633	0.545 (22)	0.364-0.727
1991*	0.411 (28)	0.243-0.578	0.304 (28)	0.134-0.473
1992*	0.589 (28)	0.422-0.757	0.479 (24)	0.318-0.640
1993	0.214 (28)	0.077-0.352	0.161 (31)	0.046-0.276
1994	0.357 (35)	0.194-0.521	0.443 (35)	0.288-0.597
1995	0.145 (31)	0.032-0.258	0.173 (26)	0.052-0.294
1996	0.500 (32)	0.361-0.639	0.480 (25)	0.315-0.645
1997	0.533 (30)	0.371-0.696	0.333 (30)	0.168-0.498
1998	0.303 (33)	0.183-0.423	0.276 (38)	0.150-0.403
1999	0.333 (33)	0.176-0.491	0.344 (32)	0.195-0.493
2000	0.444 (36)	0.305-0.584	0.485 (34)	0.345-0.626
2001	0.500 (43)	0.362-0.638	0.476 (41)	0.327-0.625
2002	0.489 (46)	0.358-0.620	0.380 (50)	0.263-0.497
2003	0.196 (46)	0.092-0.299	0.214 (49)	0.124-0.305
2004	0.409 (44)	0.273-0.545	0.390 (50)	0.277-0.503
2005	0.211 (45)	0.106-0.317	0.375 (56)	0.257-0.493
2006	0.115 (39)	0.024-0.207	0.245 (53)	0.138-0.353
2007	0.053 (38)	0.000-0.125	0.156 (49)	0.060-0.253
2008	0.311(37)	0.189-0.433	0.319(47)	0.202-0.436
2009	0.181 (36)	0.056-0.305	0.298 (42)	0.168-0.427
2010	0.317 (30)	0.165-0.469	0.225 (41)	0.329-0.121
1990-1994	**0.407**	SE=0.062	**0.386**	SE=0.069
1995-2010	**0.315**	SE=0.038	**0.323**	SE=0.026
1990-2010	**0.337**	SE=0.033	**0.338**	SE=0.026

(a) Preliminary data, values may change.